MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

13 OCTOBER 2017
9:00 A.M. – 11:00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 7 pages.
2. Answer all questions.
3. Write your answers in the Answer Booklet provided.

QUESTION 1 (8 MARKS)

a) Three horizontal ropes are attached to a boulder and produce the forces shown in **Figure Q1(a)** below.

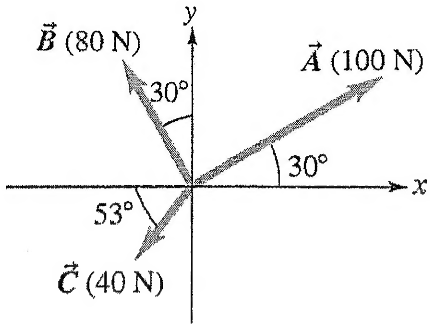

Figure Q1(a)

(i) Find the x and y components of each force. [3 marks]

(ii) Find the components of the resultant of the three forces. [3 marks]

(iii) Find the magnitude and direction of the resultant force. [2 marks]

QUESTION 2 (8 MARKS)

a) A tennis ball on Mars, where the acceleration due to gravity is 0.379g and air resistance is negligible, is thrown directly upward and returns to the same level 7.7 s later. Calculate

(i) the maximum height the ball reached above its original point. [1.5 marks]

(ii) how fast was the ball moving just after being thrown. [1.5 marks]

b) A car and a truck start from rest at the same instant, with the car initially at some distance behind the truck. The truck has a constant acceleration of 2.40 m/s^2, and the car has an acceleration of 3.70 m/s^2. The car overtakes the truck after the truck has moved 65.0 m. Calculate

(i) the time it took the car to overtake the truck. [1.5 marks]

(ii) the distance the car behind the truck initially. [1.5 marks]

(iii) the velocity of each vehicle when they were abreast. [2 marks]

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QUESTION 3 (8 MARKS)

a) A 48.5 kg box of watermelons rests on a horizontal floor. Ronaldo exerts a gradually increasing horizontal push on it, and the box just begins to move when your force exceeds 350 N. Then he reduces his force to 231 N to keep it moving at a steady speed of 24.2 m/s.

(i) Determine the coefficients of static and kinetic friction between the box and the floor.

[3 marks]

(ii) Calculate the force Ronaldo should push to give it an acceleration of 1.45 m/s^2.

[1.5 marks]

b) Boxes A and B are in contact on a horizontal, frictionless surface as shown in **Figure Q3(b)** below. Box A has mass 35.0 kg and box B has mass 14.0 kg. A horizontal force of 250 N is exerted on box A.

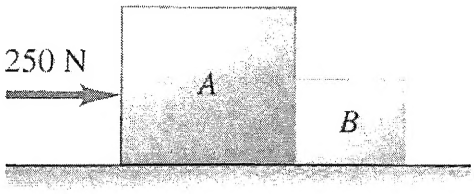

Figure Q3(b)

(i) Calculate the acceleration for each box.

[1.5 marks]

(ii) Determine the magnitude of the force that box A exerts on box B.

[2 marks]

QUESTION 4 (8 MARKS)

a) Under Damped, Critically Damped, and Over Damped are three common cases of heavily damped systems. Explain briefly all the three cases.

[3 marks]

b) A 2.50 kg mass on a spring has displacement as a function of time given by

$$x(t) = (6.30cm)\sin[(5.79rad/s)t - 1.57]$$

Find

(i) the time for one complete vibration.

[1 mark]

(ii) the spring constant.

[1 mark]

(iii) the maximum force on the mass.

[1 mark]

(iv) the speed and acceleration of the mass at t = 1.0 s.

[2 marks]

Continued...

QUESTION 5 (10 MARKS)

a) The wave function of a standing wave is

$$y(x,t) = (5.60cm)\cos[(0.35rad/cm)x]\cos[(50.0rad/s)t]$$

(i) Determine the resultant amplitude of the standing wave in terms of x. [0.5 mark]

(ii) Find the positions of the nodes. [2.5 marks]

(iii) Find the positions of the antinodes. [2.5 marks]

b) A stationary police car emits a sound of frequency 1500 Hz that bounces off a car on the highway and returns with a frequency of 1570 Hz. The police car is right next to the highway, so the car is either traveling directly toward or away from it. (Given the speed of sound in air that day is 344 m/s)

(i) Determine whether the car is moving toward or away from the police car. [0.5 mark]

(ii) Calculate how fast the moving car going. [2 marks]

(iii) Calculate the frequency the police will receive if it had been traveling toward the other car at 21.0 m/s [2 marks]

QUESTION 6 (8 MARKS)

a) **Figure Q6(a)** shows a layer of water covers a slab of material X in a beaker. A ray of light traveling upward follows the path indicated. Given that the refractive index of air and water are 1.0 and 1.33, respectively. Using the information given on the figure, calculate

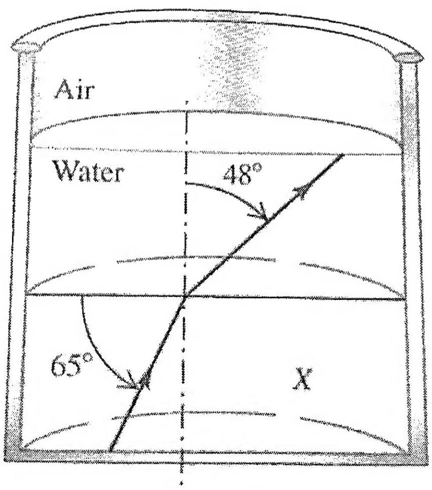

Figure Q6(a)

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(i) the index of refraction of material X.

[1.5 marks]

(ii) the angle the light makes with the normal in the air.

[1.5 marks]

b) Two thin parallel slits that are 0.0115 mm apart are illuminated by a laser beam of wavelength 569 nm.

(i) On a large distant screen, determine the total number of bright fringes, including the central fringe and those on both sides of it.

[2 marks]

(ii) Find the angle of the bright fringe, relative to the original direction of the beam, that is most distant from the central bright fringe occur.

[1.5 marks]

(iii) Determine the distance from the central bright fringe to the most distant bright fringe observed on the screen if the screen is 25.7 m away from the slits.

[1.5 marks]

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APPENDIXES

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	9.11×10^{-31} kg
Proton mass,	m_p	=	1.67×10^{-27} kg
Neutron mass,	m_n	=	1.67×10^{-27} kg
Magnitude of the electron charge,	e	=	1.602×10^{-19} C
Universal gravitational constant,	G	=	6.67×10^{-11} N.m^2 kg^{-2}
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	1.38×10^{-23} J/K
Compton wavelength,	λ_c	=	2.426×10^{-12} m
Planck's constant,	h	=	6.63×10^{-34} J.s
		=	4.14×10^{-15} eV.s
Speed of light in vacuum,	c	=	3.0×10^{8} m/s
Rydberg constant,	R_H	=	1.097×10^{7} m^{-1}
Acceleration due to gravity,	g	=	9.81 m s^{-2}
1unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	1.66×10^{-27} kg
1 electron volt,	1 eV	=	1.60×10^{-19} J
Avogadro's number,	N_A	=	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing,	I_o	=	1.0×10^{-12} W m^{-2}
Coulomb constant,	$k = \dfrac{1}{4\pi\varepsilon_o}$	=	9.0×10^{9} Nm^2 C^{-2}
Permittivity of free space,	ε_o	=	8.85×10^{-12} C^2/N.m^{-2}
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ (T.m)/A
1 atmosphere pressure,	1 atm	=	1.0×10^{5} N/m^2
			1.0×10^{5} Pa
Earth: Mass,	M_E	=	5.97×10^{24} kg
Radius (mean),	R_E	=	6.38×10^{3} km
Moon: Mass,	M_M	=	7.35×10^{22} kg
Radius (mean),	R_M	=	1.74×10^{3} km
Sun: Mass,	M_S	=	1.99×10^{30} kg
Radius (mean),	R_S	=	6.96×10^{5} km
Earth-Sun distance (mean),		=	149.6×10^{6} km
Earth-Moon distance (mean),		=	384×10^{3} km

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LIST OF FORMULA

Differential Rule	Trigonometric Identity
$y = kx^n$ $\dfrac{dy}{dx} = knx^{n-1}$	$\sin = \dfrac{opposite}{hypotenuse}$ $\cos = \dfrac{adjacent}{hypotenuse}$ $\tan = \dfrac{opposite}{adjacent}$ $\sin\alpha + \sin\beta = 2\cos\left(\dfrac{\alpha-\beta}{2}\right)\sin\left(\dfrac{\alpha+\beta}{2}\right)$ $\sin(\alpha-\beta)+\sin(\alpha+\beta) = 2\sin\alpha\cos\beta$

NEWTONIAN MECHANICS

$v = \dfrac{\Delta x}{\Delta t}$ $a = \dfrac{\Delta v}{\Delta t}$ $v = v_o + at$ $x - x_o = v_o t + \dfrac{1}{2}at^2$

$v^2 = v_o^2 + 2a(x - x_o)$ $x - x_o = \left(\dfrac{v_o + v}{2}\right)t$

$v = v_o + gt$ $y - y_o = v_o t + \dfrac{1}{2}gt^2$ $v^2 = v_o^2 + 2g(y - y_o)$ $y - y_o = \left(\dfrac{v_o + v}{2}\right)t$

$W = Fs\cos\theta$ $W = mg$ $\sum F = F_{net} = ma$ $f_s \le \mu_S F_N$

$f_k = \mu_K F_N$ $p = mv$ $\sum F = \dfrac{\Delta p}{\Delta t}$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ $m_1u_1 + m_2u_2 = (m_1 + m_2)\,v$ $P = \dfrac{W}{t} = \dfrac{E}{t} = \dfrac{Fd}{t} = F\bar{v}$

$K = \dfrac{1}{2}mv^2$ $PE_s = \dfrac{1}{2}kx^2$ $F_s = -kx$ $PE_G = mgy$

$v_{circular} = \dfrac{2\pi r}{T}$ $a_c = \dfrac{v^2}{r}$ $F_g = G\dfrac{m_1 m_2}{r^2}$ $U_g = -G\dfrac{m_1 m_2}{r}$

$T^2 = K_s r^3$ $T_s = 2\pi\sqrt{\dfrac{m}{k}}$

Spring with mass, Simple pendulum,

$\omega = \sqrt{\dfrac{k}{m}}$ $\omega = \sqrt{\dfrac{g}{l}}$ $T_p = 2\pi\sqrt{\dfrac{l}{g}}$ $T = \dfrac{2\pi}{\omega} = \dfrac{1}{f}$

Cosine Wave:
$x = A\cos\omega t$
$v = -\omega A\sin\omega t$
$a = -\omega^2 A\cos\omega t$

Sine Wave:
$x = A\sin\omega t$
$v = \omega A\cos\omega t$
$a = -\omega^2 A\sin\omega t$

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WAVES AND OPTICS

$v = f\lambda$ $\omega = 2\pi f$ $n = \frac{c}{v}$ $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_c = \frac{n_2}{n_1}$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$ $f = \frac{R}{2}$

$d\sin\theta_{\max} = m\lambda$ $a\sin\theta_{\min} = m\lambda$ $d\sin\theta_{\min} = (m+\frac{1}{2})\lambda$

$y_{bright} = \frac{m\lambda L}{d}$ $y_{dark} = (m+\frac{1}{2})\frac{\lambda L}{d}$ $I = \frac{P}{A}$ $\beta = 10\log_{10}\frac{I}{I_o}$

$f' = f\left(\frac{v \pm v_o}{v \mp v_s}\right)$ $y(x,t) = A\sin(kx \pm \omega t + \phi)$

Wave Type:

$$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$$

$$y(x,t) = 2A\sin\ kx\ \cos\omega t$$

End of paper.